GEOGRAPHY OF INNOVATIVE ACTIVITIES IN THE ANDALUSIAN AEROESPACE CLUSTER

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1.INTRODUCTION.

The emergence of clusters of high-tech corporations in specific locations have been the object of study for many researchers in the last decades. In this respect, scholars have analyzed its components and dynamics, in order to understand what is the connection between spatial clusterization of firms and innovation. Different models have explained these formations, the most outstanding in the last years are Perroux's industrial poles, Becattini's industrial districts, Porter's clusters, Castells' Innovation environments, and Cooke's Regional innovation systems. All, models have in common the presence of Hi-tech industries, and connections between firms and university research, and public and private research institutions.

After Airbus decision of setting up its third final assembly line (FAL) in the city of Seville, the Andalusian aerospace cluster has experimented a great development. This event gave birth to the Andalusian regional administration decision of creating two Technology Parks ad hoc, in order to create a competitive and innovative aerospace cluster. Therefore the purpose of this paper is twofold: the first consists in the analysis of significant differences between aerospace firms inside and outside the innovative areas (IA), in terms of innovation. The second tried to determine which factors have the strongest effect on the attraction of innovative firms.

2.MATERIALS AND METHODS.

To carry out these targets, it was necessary to collect information about innovation activities of Andalusian aerospace firms, and about the attraction factors that pull innovative companies to IAs. Thus, it was devised a scheme to study innovation and firm attraction based on the literature review that helped to select all the variables necessary to carry out the analysis. Since many of the needed variables weren´t available at the public statistics office, a sample of 100 aerospace firms, which represented the whole Andalusian aerospace cluster, was collected.

The method used to achieve both objectives was composed of two parts. The first consisted in selecting a set of variables that define an innovative company. The

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variables employed to estimate firm innovation were extracted from the parameters used in the models of Griliches (1979), Jaffe (1989), and Audrescht y Feldman (1996), to study innovation and knowledge externalities. Oslo manual, and Eurostat Community Innovation system (CIS, 2010) were considered too. Hence, a firm was considered as innovative if three criterion were fulfilled: firms introduced new products, services, or process completely new to the national, European, or world market, in the last three years. The second requirement was that at least 5% of total revenue would be invested in R&D[1] activities. After defining the variable "innovative firms", it was used to analyze differences on innovation activities between the firms placed inside and outside the IAs. The third condition was fulfilled if the company acquired knowledge from customer, suppliers, competitors, universities, or public and private institutions. Hence, the input information to analyze consisted in two nominal variables coded with binary data that were introduced in a SPSS crosstabs test to check the relation between the two parameter.

The second part, consisted in extracting from the literature review the main attractors of innovative firms to the IAs, devising variables which collected accurate information about them. The variables selected were:

- Access to aerospace university graduates.
- Access to university research.
- International connectivity
- Access to mid-qualified aerospace workers.
- Research facilities inside the park.
- Price and space availability
- Grants
- Presence of foreign firms
- Impact on the corporation image
- Proximity to suppliers
- Proximity to customers
- Knowledge externalities

3.RESULTS.

As to the first part, the result of the test showed that there was a significant difference in innovative performance between firms located inside and outside IAs, and besides, the test of Phil and Cramer reveals a correlation of 0,7.

After that, the variable innovation has been displayed on a map in order to carry out a spatial analysis that confirmed the results of the test. The location of the sample companies was aggregated into 9 spaces: four IAs (Seville Aeropolis, PCyT Cartuja, Tecnobahía, PT Andalucía), and five other spaces corresponding to the metropolitan

[1] The usual rate of investment in this industry is 15% (Fundación Helice, 2011)

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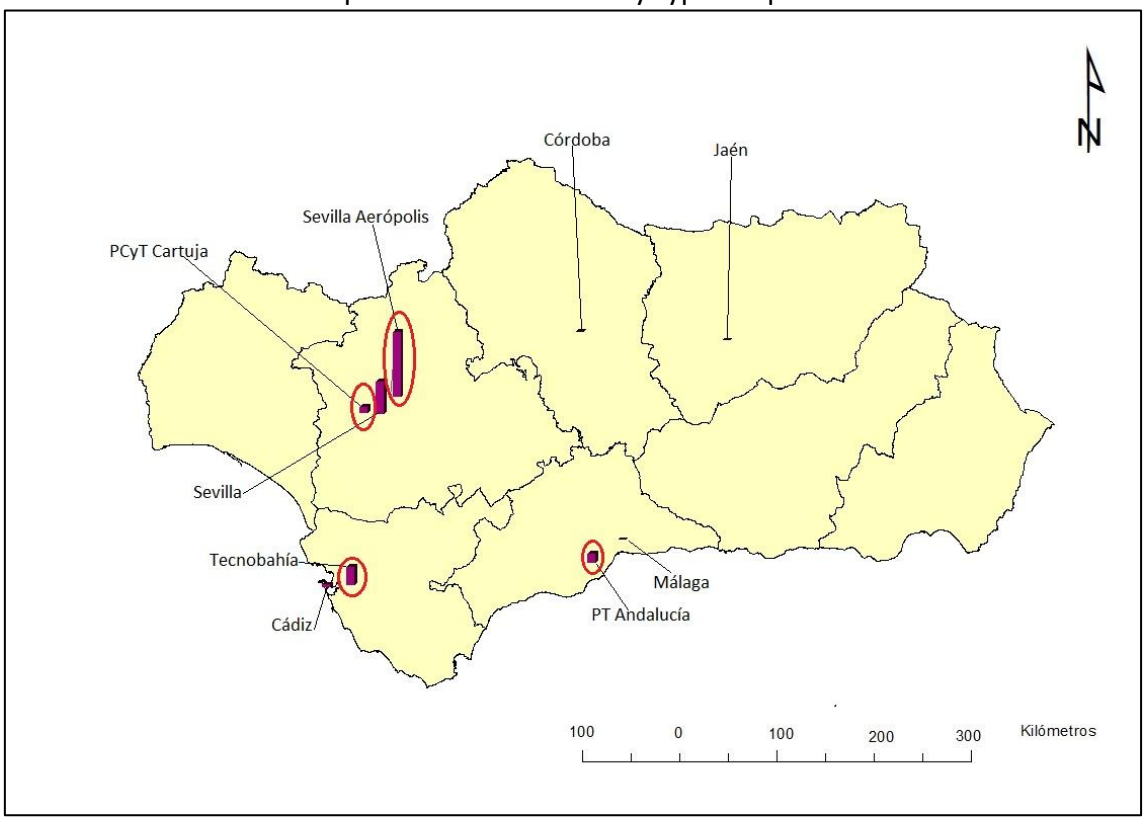
areas of Seville, Cádiz, Malaga, Córdoba, and Jaen. The summarizing method consisted in the average value of innovation performance for all the firms located in any of these 9 spaces. The results showed the rate of innovative companies per area, and were ranked using this variable. The order was as follows: Sevilla Aerópolis, Seville, Tecnobahía, PT Andalucía, Cadiz, Malaga, Cordoba and Jaen. The percentage of innovative firms of IAs was 75%, and the percentage outside them was 25%.

Map 1. Innovative firms by type of space.



Source: Compiled by the author based on the Survey.

The second objective of this paper was to analyze the effect of attraction factors on the innovative firms to relocate to IAs. To this purpose it was used a model of logistic regression that determined the importance of each attraction factor to the IAs, and to exclude any of them if they were not significant. The procedure started by running a test of bivariate correlation. The results showed correlation between variables "type of space", and other variables like "knowledge externalities", "access to aerospace university graduates", "customer proximity", "research facilities inside the park", "access to mid-qualified aerospace workers".

After running the first test, some variables like "access to mid-qualified aerospace workers" have been excluded as they didn't have any significance in the model. Finally, after the introduction of predictor "grants", all variables had a significance of at least $p<0,05$, the model increased the explained variance by 4,8% up to 80%, and improved

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the Nagelkerke R^2 augmented from 0,57 to 0,617. The variables selected in the model ordered by its Odds Ratio were: knowledge externalities (2,457), customer proximity (1,876), access to aerospace university graduates (1,780) and grants (0,34). The three former coefficients are positive which means that an increase in the effect of these variables would increase the likelihood of moving to an IA. On the other hand, the negative coefficient for variable "grants" implies that an increase in the rating of this variable would lead to a decrease in the likelihood of moving to an IA.

4. DISCUSSION.

The results of both analysis rejected H_0, and confirmed H_1 for $p < 0.05$ or lower in some cases, therefore, the set of variables for both models are significant.

As to hypothesis 1, H_0 has been rejected since the test showed significant differences for a p value < 0.05 and the correlation test of Phil and Cramer also provided a high value (0,7). Therefore, the likelihood of investing in R&D, or to develop new products, services or processes new to the global market is higher in IAs than outside them.

One explanation for this result comes from aerospace industry organization. The strategy of many OEMs consist in outsourcing to firms Tier1 and 2, components parts and its corresponding innovation efforts. Therefore as firms that receive outsourced packages innovate and stay close to Airbus, they will be likely be placed in an IA, as all Airbus facilities are established in an IA. In addition, the observed connection between innovation and space clustering of Hi-tech firms shows relation with the innovation models reviewed in the introduction of this paper.

However, the spatial distribution of this variable, revealed an alternative interpretation of the results. Certainly, the test have proved that innovative companies are specially located in IAs, but a slightly different explanation can be made of the results. This argument comes from the fact that, the second innovative space in the rank, is the agglomeration of Seville, and is quite distant to the next which is Tecnobahía. One explanation for these results could be that the most important facilities of Airbus, (the only OEM in Andalusia), and 80% of Andalusian aerospace firms are established in Seville. Thus, these two factor could be involved in the fact that the likelihood of being innovative is very high in Seville. This argument could be supported by the fact that Airbus strategy is to outsource parts and components of the production in favor of Tier1 and Tier2 companies, and the outsourced parts need great efforts in R&D, and tight interrelation between both firms. Therefore, the alternative explanation could be that the proximity to an important OEM facilities would encourage firms to relocate close to them.

As to the hypothesis 2, H_0 can be rejected since all the coefficients are significant. The model only selected four variables which are significant at $p<0.05$. Thus the most important attractors are "knowledge externalities", "Customer proximity", Access to

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aerospace university graduates, and "grants".

The first predictor of the model comes to support Audrescht and Feldman findings about the importance of knowledge externalities as attraction factor to hi-tech firm agglomerations. Corporations are interested in upgrading their technology base in an industry where knowledge is the key for competitive advantage. Furthermore, because of the tacit nature of knowledge externalities their influence has geographic boundaries. So from the connection between variables firms established in IAs and interest for knowledge externalities can be inferred that these boundaries match with the IAs extent.

As for the customer proximity, it proved to be the second most important factor in the model, and the reason behind this result may have to do with aerospace industry organization. Since big OEMs' strategy is to outsource parts of production as well as its corresponding R&D risks, interface teams from both firms must meet frequently for product designing, joint testing, etc. This tight collaboration is only possible if plants are close in space, otherwise the transportation costs would increase enormously. Hence, the way to reduce transportation costs in Tier1, 2 and 3 firms is to approximate to its main customer which usually is Airbus. This argument supports the importance given to transportation cost in Perroux industrial poles.

The third factor of attraction in the model was the access to aerospace university graduates. The model consider that the increase of this variable would augment the dependent variable in more than one unit. Besides, the analysis of the spatial distribution of this predictor shows higher values inside AIs than outside, therefore supports the model. Nevertheless, all type of spaces that belong to Seville and Cadiz have almost the same access to the University of Seville and Cadiz. An additional explanation could be that companies that scored high on this item are innovative firms that need qualified manpower, and as proved in the hypothesis 1, most of innovative firms are located in IAs. Thus, this variable seem to be dependent on other variable which is concentrated on IAs, like innovation.

The fourth factor selected by the model was the variable "grants". This predictor was given a negative coefficient which means that if a company relocates due to grants, the likelihood to stay in an innovative area decreases. The reason for this lays in the fact that grants are available for companies that locate in AIs, but most of them are available for corporations that innovate. Since the eligibility criteria is fulfilled by many companies, the differences between firms inside and outside the IAs are small.

There are some factors that it supposed to be attractors, but they were not significant. One of them is the collaboration with universities to carry out R&D inside the company. Other is the non-significant facilities of IAs. And the last important factor non-significant is the proximity to port and airport infrastructure.

Finally the analysis performed in this paper allowed to extract the following conclusions. Most of companies that locate in IAs are innovative. And if a firm decide to relocate to benefit from knowledge externalities or to approximate to its customer, it will likely go to a IA, on the contrary if its willing to move to obtain grants the likelihood of moving to a IA decreases.

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